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PATENT APPLICATION

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Title: **TELECOMMUNICATIONS RADIO SYSTEM FOR MOBILE COMMUNICATION SERVICES**

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S I R:

SUBMISSION OF PRIORITY DOCUMENT

In connection with the above-captioned application, applicants enclose the following certified priority document and English-language translation, to support the claim to priority:

German Appl. No. 102 33 172.3; filed July 22, 2002.

Respectfully submitted,

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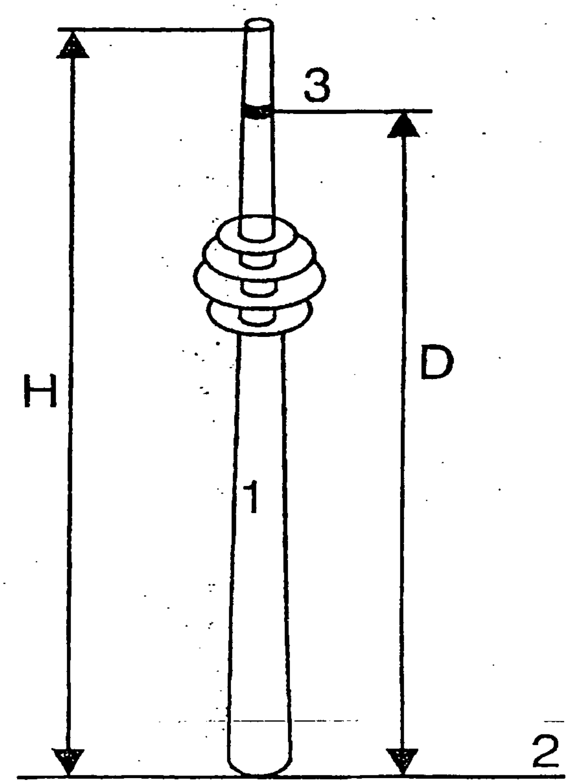
The following details have been taken from the documents submitted by the Applicant

(54) Title: **Telecommunications systems for a UMTS radio supply**

(57) Abstract: The invention relates to a telecommunications system for a UMTS radio supply. The invention describes how, in practice, a complete town or a large region can be supplied quickly and without high investment costs.



Description

Prior art

According to the relevant literature (for example Araki [1], MacDonald [2]) there is an aim of splitting the area to be supplied into hexagons which are as uniform as possible and at each of whose centres a base station is located. In the simplest case, signals are emitted via omnidirectional antennas from this centre point. However, nowadays, at least triple sectorization is generally used, that is to say three sectors, with aperture angles of typically 120° each, are covered from the location by separate antennas (already described in [2]).

The original homogeneous cellular concept was later on generalized in a number of directions. [2] has likewise already described the cell size being matched to different traffic densities by reducing the diameter (cell splitting). Lorenz [3] proposes splitting into six sectors of 60° each (this variant was later on strongly supported by the company Motorola and is used in a number of mobile radio networks). Halpern [4] subdivides omnidirectional and triple-sectorized systems once again into concentric rings; this concept will be implemented later by Nokia in the form of the "Intelligent Underlay-Overlay" feature for the GSM system. This concept has the characterizing feature of having the same number of sectors in each of the concentric rings.

In practice, landscape, traffic and acquisition factors mean that there are greater or lesser discrepancies from the ideal geometric shapes of the relevant literature in the form of distortion of the hexagonal geometry resulting from the non-ideal location of the base station. Nevertheless, the base station is generally located at the centroid of the region

supplied by it, and covers a maximum of six sectors from there. High locations are regarded as artificial faults, since they lead to high undesirable interference.

Nowadays, omnidirectional antennas are used only rarely. Double sectorization is used when supplying purely linear paths (roads, railways).

The process of obtaining UMTS licences has resulted in numerous companies reaching the limits of their financial capabilities. There is therefore a need to quickly install a UMTS network covering a particular area, at least in larger cities. However, this aim is being obstructed for the following reasons:

- too few qualified personnel for planning,
- lack of suitable locations (good locations are generally already being used),
- considerable problems with renegotiations relating to existing locations,
- major loss of time due to harmonization with other network operators (often because of repeated planning changes),
- very major resistance from the population to new installations (EMC concerns),
- owing to these EMC concerns, it is virtually impossible to acquire new locations or even to maintain existing locations once the rental contract has elapsed,
- location rents are reaching astronomic heights,
- expensive conversion of the existing landline network (personnel and location problems).

It is therefore already apparent that UMTS network construction will be possibly only very slowly and with major financial commitment. Furthermore, it can thus be expected that all that would be possible would be a network with significant holes. Specialists are

therefore already saying that it would be scarcely possible to satisfy the demand for a homogeneous network in the foreseeable future.

Object

The invention is based on the object of providing a telecommunications network for a UMTS radio supply for a region of any size, for example a town, a county or state, which can be set up relatively quickly and at low cost.

Solution

The object is achieved by the features of each of the independent claims.

Further inventive refinements

Further inventive refinements are described in Patent Claims 6 to 10 as well as 16 to 26.

A number of the advantages

The UMTS telecommunications network according to the invention makes it possible to supply a complete town or the like from only one location by means of a very finely sectorized system. This will make it possible to overcome virtually all of the previous problems, because it will result in the following advantages:

- a concentrated location thus allowing considerable savings in the landline network since virtually no landline network need be provided, inter alia involving rental, setting-up costs to synergy savings, for example a major power supply or other infrastructure, maintenance personnel or the like,
- setting up can take place, so to speak, "overnight", thus resulting in a considerable competitive

advantage over other licence holders since an extremely homogeneous network which will cover the area completely and will not have any gaps would be available,

- this would also considerably simplify the introduction of novel features (new system hardware, software) into the network.

By way of example, the UMTS telecommunications system could be implemented using an already existing television tower. It is desirable for the UMTS telecommunications system according to the invention to have a high tower with a height of not less than 50 metres, and preferably 90 to 320 metres.

Data and facts based on the example of the television tower in Nuremberg: it would be possible to use a height of 280 m (for very extensive antenna systems as well) on the television tower, and space would also be available (at the top) for system engineering (so that the cable runs are short).

Sectorization must be carried out very finely in order to achieve an appropriate power flux density on the ground, as well as to provide sufficient capacity.

By way of example, two rings would be worthwhile, in which case the outer ring would have to be more finely sectorized (owing to the larger circular area and owing to the fact that the area increases with the square of the increasing distance).

The following configuration would thus be feasible: the inner ring would have 24 sectors (each therefore covering a 15° horizontal angle range). The outer ring would comprise 72 sectors (each therefore covering a 5° horizontal angle range).

The vertical aperture angle of the inner antennas must be 10°, and would thus cover a range zone from 1 to 3.2 km with a tilt of around 10°.

The vertical aperture angle of the outer antennas must be 5°, and would thus cover a range zone from 3.2 km to 6.4 km (antenna centre) and as far as the horizontal (0°) with a tilt of around 2.5°.

Each segment (inner or outer) thus has an area of around 1.33 km^2.

This would result in a relatively uniform power flux density of -21 dBm/m^2 over the entire coverage area (with a transmission power of 10 W per segment). Assuming line of sight, this would still correspond to a level of -49 dBm at the mobile telephone (0 dBi antenna).

This level should also ensure adequate indoor coverage. In principle, this would result in the advantages of an extremely homogeneous network (without interference problems resulting from different propagation paths from different stations), thus making it possible to achieve high transmission capacities in the individual segments. The coverage in the boundary areas of the individual segments can be compensated for by means of the macrodiversity functionality of the power drop, and a good "soft" (depending on the definition of the expression "soft") handover.

Individual neighbourhood planning (as has been the norm until now) with the corresponding quality problems can be replaced by simple systems engineering (a maximum of seven neighbours for an inner segment, and a minimum of three (or four) neighbours for an outer segment). The time and quality advantage are also clearly in favour of a system such as this.

The system should be operated at only one of the two freuqencies. Around 50 000 customers (10 applications per UMTS channel at the same time, 96 sectors and 20 mErl/customer in each case) would thus be feasible, which should in fact be sufficient for the start of the network.

Future reliability of the system is likewise provided. If a particularly large amount of traffic were to occur in one segment, then the location at which this traffic occurs can be determined very precisely, since the angle (segment) and the range (delay time) are known. A UMTS station could thus be set up there at the second frequency, providing a local supply for this hot spot. The advantage would be that there would be no need to make any assumptions about the position of hot spots, which can be determined quite specifically with further stations then being set up only there.

If UMTS is highly successful, subsequent compression can be achieved with virtually any desired number of stations at the second frequency. However, gap-free network coverage need not be borne in mind in this case, since retrospective improvements could be made on a highly localized basis at any time.

Summary: The envisaged idea represents an optimum in terms of the saving in setting up a network (as well as loss in the case of a "UMTS flop"). The 100% area coverage offered immediately at the start of the network would, in particular, be a major advantage.

Exemplary embodiment

The invention will be described in the following text by way of example and only schematically on the basis

of a television tower, such as that in Nuremberg. In the figures:

Figure 1 shows a schematic side view of a tower, and Figure 2 shows a plan view of a tower with two rings, arranged concentrically with respect to one another, of UMTS antennas arranged in the form of sectors.

The tower 1 which is shown in Figure 1 has a height H of, for example, 180 to 450 m, preferably about 200 to 280 m. At least one ring 3, which has a circular plan view, of UMTS antennas designed in the form of sectors is arranged at a distance D from the installation base 2.

In the embodiment shown in Figure 2, it can be seen that there are two rings of antennas in this case, an outer ring 4 and an inner ring 5.

The inner ring 5 has 24 sectors 6 of antennas, which each cover a 15° horizontal angle range.

In contrast, the outer ring 4 is subdivided into 72 sectors 7, which each cover a 5° horizontal angle range.

The vertical aperture angle of the inner antennas is 10°, and would thus cover a range zone from 1 to 3.2 km with a tilt of around 10°.

The vertical aperture angle of the outer antennas is 5°, and would thus cover a range zone from 3.2 km to 6.4 km (antenna centre) up to the horizontal (0°) with a tilt of around 2.5°.

Each sector 6 or 7, to be precise irrespective of whether it is an inner or outer sector, thus has an area of around 1.33 km^2.

The features described in the abstract, in the patent claims and in the description, and illustrated in the drawing as well, may be significant to the implementation of the invention both individually and in any desired combinations.

List of reference symbols

1	Tower
2	Installation base
3	Ring, UMTS antenna
4	Ring, outer, UMTS antenna
5	Ring, inner, UMTS antenna
6	Sector, "
7	Sector, "
D	Distance between the antennas and the installation base 2
H	Height of the tower 1

List of references

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[1] Araki, K.: "Fundamental problems of nation-wide mobile radio systems" Review of the Electrical Communication Laboratory, vol. 16 (1968), 357-373

[2] MacDonald, V.H.: "The Cellular Concept" The Bell System Technical Journal, vol. 58 (1979), 15-41

[3] Lorenz, R. W.: "Kleinzonennetze für den Mobilfunk" Nachrichtentechnische Zeitschrift [Small zone networks for mobile radio, Information Technology Journal], Vol. 31 (1978), 192-196

[4] Halpern, S.W.: "Reuse partitioning in cellular systems" Proc. 33rd IEEE Vehicular Technology Conference (1983), 322-327

Patent claims

1. Telecommunications system for a UMTS radio supply for a region of any given shape with the aid of a location on or at which more than six sectors (6, 7 - radio cells) are in use.

2. Telecommunications system for a UMTS radio supply for a region of any given shape with the aid of a location on or at which more than eleven sectors (6, 7 - radio cells) are in use.

3. Telecommunications system for a UMTS radio supply for a region of any given shape with the aid of a location on or at which more than 24 sectors (6, 7 - radio cells) are in use.

4. Telecommunications system for a UMTS radio supply for a region of any given shape with the aid of a location on or at which more than 48 sectors (6, 7 - radio cells) are in use.

5. Telecommunications system for a UMTS radio supply according to Claim 1 or one of the subsequent claims, characterized in that the location has a high building, for example a multi-storey building, a tower (1), in particular a radio tower or the like, on which the sectors (6, 7 - radio cells) are arranged.

6. Telecommunications system for a UMTS radio supply according to Claim 1 or one of the subsequent claims, characterized in that the vertical incidence angle of the radio waves with the horizontal is greater than 0.5°.

7. Telecommunications system for a UMTS radio supply according to Claim 1 or one of Claims 2 to 5,

characterized in that the vertical incidence angle of the radio waves with the horizon is greater than 1°.

8. Telecommunications system for a UMTS radio supply according to Claim 1 or one of Claims 2 to 5, characterized in that the vertical incidence angle of the radio waves with the horizon in the supply region is always greater than 1°, and the number of sectors (6, 7 - radio cells) is so great that, by reducing the supply area of one sector (6 or 7), the power flux density or the network capacitance is, conversely, so high that the technical and financial demands on the UMTS network are satisfied.

9. Telecommunications system for a UMTS radio supply according to Claim 1 or one of Claims 2 to 5, characterized in that the vertical incidence angle of the radio waves with the horizontal in the supply region is always greater than 1°, and the maximum number of sectors (6, 7 - radio cells) is so great that a sufficient power flux density, but at least -80 dBm, is provided within the supply region, or the required network capacity in the corresponding region is achieved.

10. Telecommunications system for a UMTS radio supply according to Claim 1 or one of Claims 2 to 5, characterized in that the sectors (6, 7 - radio cells) produce supply regions which are not only mathematically in the form of sectors, that is to say a radial arrangement of supply regions purely from the supply location, but, for example, is also distinguished by mixing of a radial and concentric subdivision of the supply regions, and in that the overall supply region and the installation height of the antennas are

characterized in that the vertical incidence angle with the horizontal of the radio waves in the supply region is always greater than 1° and the maximum number of sectors (6, 7 - radio cells) is so great that a sufficient power flux density, but at least -80 dBm, is provided within the supply region, or the required network capacity in the corresponding region is achieved.

11. Telecommunications system for a UMTS radio supply for an approximately circular, polygonal or, for example, partially circular region - a town, district, county or state - using at least one high building - multi-storey building, tower (1) or the like - with the region being subdivided into a large number of sector-like surface areas, whose area extent can be determined on the basis of the desired power flux density and network capacity, in which case the individual surface areas can each be supplied by a separate antenna, or else all the surface areas can be supplied by a phase-controlled antenna at the same time.

12. Telecommunications system for a UMTS radio supply for a large approximately circular, polygonal or, for example, partially circular region - a town, district, county or state - using at least one high building (1) like a tower, which is arranged at an exposed location - hill, mountain - with the respective region to be supplied being subdivided into a large number of sector-like surface areas, whose area extent can be determined on the basis of the desired power flux density and the network capacity, in which case the individual surface areas can each be supplied by a separate antenna, or else all the surface areas can be supplied by a phase-controlled antenna at the same time, and with the antennas in each case being arranged as

high as possible above the installation base of the building (1).

13. Telecommunications system for a UMTS radio supply for a large, approximately circular, polygonal or, for example, partially circular region - a town, district, county or state - using at least one high building - multi-storey building, tower (1) or the like - with the region being subdivided into more than six sector-like surface areas, whose area extent can be determined on the basis of the desired power flux density and network capacity, in which case the individual surface areas can each be supplied by a separate antenna or else all the surface areas can be supplied by one phase-controlled antenna at the same time, and the antennas are each arranged as high as possible above the installation base.

14. Telecommunications system for a UMTS radio supply for a large, approximately circular, polygonal or, for example, partially circular region - a town, district, county or state - using at least one tall building - television tower, radio tower (1) or the like - with the region being subdivided into more than eleven sector-like surface areas, whose area extent can be determined on the basis of the desired power flux density and network capacity, in which case the individual surface areas can each be supplied by a separate antenna, and the individual antennas are arranged on a plane which is arranged orthogonally with respect to the longitudinal axis of the building (1).

15. Telecommunications system for a UMTS radio supply for a large, approximately circular, polygonal or, for example, partially circular region - a town, district, county or state - using at least one

tall building - television tower, radio tower (1) or the like - with the region being subdivided into more than 24 sector-like surface areas, whose area extent can be determined on the basis of the desired power flux density and network capacity, in which case the individual surface areas can each be supplied by a separate antenna, and the individual antennas are arranged on a plane which is arranged orthogonally with respect to the longitudinal axis of the building (1), and with antenna sectors (6, 7), which supplement one another to form imaginary circles, being arranged concentrically about the longitudinal axis of the relevant tower-like building (1).

16. Telecommunications system according to Claim 1 or one of the subsequent claims, characterized in that the number of antennas which are formed as sectors (6, 7) in an outer ring (4) is greater than the number of antenna sectors in an inner ring (5) whose diameter is smaller.

17. Telecommunications system according to Claim 1 or one of the subsequent claims, characterized in that radio antennas having a sector angle which is less than that of the radio antennas which are arranged in an inner ring (5) (which is arranged concentrically with respect thereto) and which have a considerably smaller sector angle are arranged in an outer ring (4) on the tower (1).

18. Telecommunications system according to Claims 16 or 17, characterized in that the number of sectors (7) in the outer ring (4) is considerably greater than the number of sectors (6) in the inner ring (5).

19. Telecommunications system according to Claim 16 or one of the subsequent claims, characterized in that 24 sectors (7) are arranged in the outer ring (4), and 72 sectors (6) of radio antennas are arranged in the inner ring (5).

20. Telecommunications system according to Claim 16 or one of the subsequent claims, characterized in that the vertical aperture angle of the antennas in the inner ring (5) is about 8° to 12°, preferably 10°.

21. Telecommunications system according to Claim 16 or one of the subsequent claims, characterized in that the vertical aperture angle of the antennas in the outer ring (4) is approximately 3° to 6.5°, preferably 5°.

22. Telecommunications system according to Claim 1 or one of the subsequent claims, characterized in that a range zone from 3.2 km to 6.4 km (measured from the antenna centre) to the horizon (0°) is covered.

23. Telecommunications system according to Claim 18 or one of the subsequent claims, characterized in that each sector (6, 7) covers an area of about 1.33 km^2.

24. Telecommunications system according to Claim 15 or one of the subsequent claims, characterized in that the vertical aperture angle of the supply antenna aperture (3) is chosen such that the antenna (3) as far as possible supplies only the respective sector region (6, 7) and as little power as possible is emitted from this antenna (3) into its adjacent sectors (6, 7).

25. Telecommunications system according to Claim 1 or one of the subsequent claims, characterized in that, in order to avoid interference problems, the near area of the system can be supplied by separate individual antenna sectors (6, 7) which are arranged in a lower height area on the building (1).

26. Telecommunications system according to Claim 1 or one of the subsequent claims, characterized in that conventional base stations, which are operated at a different frequency, are provided in order to dissipate local high traffic volumes.

Two pages of drawings attached

Attached drawings

Fig.1

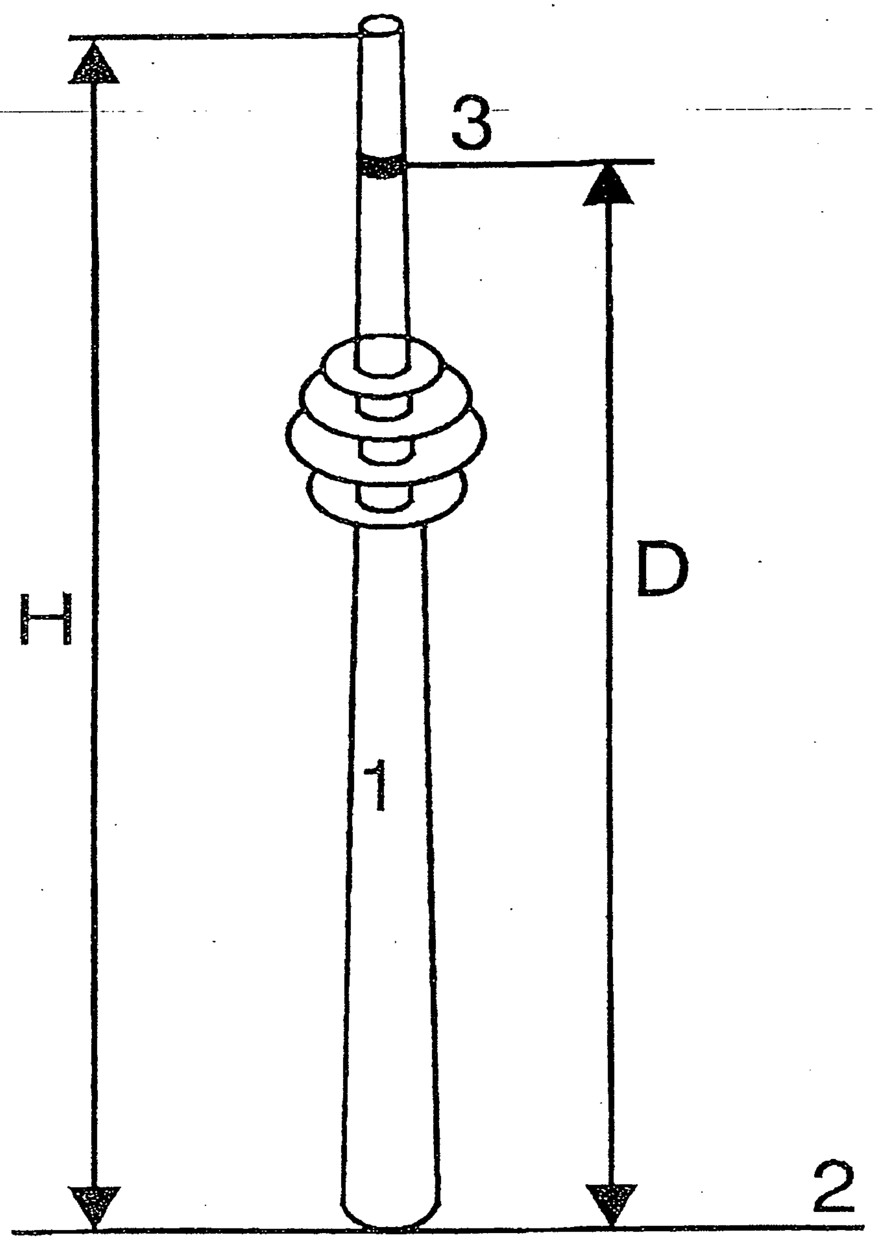

Fig.2